

## ***Interactive comment on “Ground surface temperatures indicate the presence of permafrost in North Africa (Djebel Toubkal, High Atlas, Morocco)” by Gonçalo Vieira et al.***

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The paper "Ground surface temperatures indicate the presence of permafrost in North Africa (Djebel Toubkal, High Atlas, Morocco)" is very interesting because it describes the possible presence of permafrost in the highest massif of northern Africa. The Atlas mountain permafrost has not been previously studied, so it is of interest to have a first approximation on permafrost in North Africa. This approach focuses on a small size area, although located in the highest massif of the Atlas, so it is significant to detect the possible presence of mountain permafrost. The paper is well structured and the figures clear and informative. The article presents a clear, simple and sufficiently contrasted methodology, which in my opinion is sufficiently effective to achieve the objectives, to

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detect the possible presence of permafrost in the Toubkal massif. The comparison with the climatic conditions presents strong limitations, as the soil temperatures are compared with extrapolations. This is the weakest point, although with the above limitations, the work and the results are useful to compare the estimated environmental conditions with the soil records. The analysis of landforms is poor. A mapping of significant active periglacial landforms can support very good information, joint the snow permanence. Some active landforms are good indicators of permafrost or seasonal ice and have been used by numerous authors. In the text differences between lobate deposits and transverse ridges and furrows have been established. A greater accuracy on existing periglacial active landforms can allow the localization of frozen soils. Mapping and differentiation between landforms as gelifluction lobes, protalus lobes, frost mounds or rock glaciers, show places where are developed and where they are not developed, and they can permit extrapolate the frozen ground from the sites where data loggers have been located with the surroundings. The conclusions are in line with the data obtained and are relevant for the basic characterization of possible seasonal grounds or permafrost in the massif, offering the possibility of future mapping of permafrost in the massif. So, the paper is suitable for *The Cryosphere* with very minor corrections.

From a formal perspective, several errata have been detected:

Pag. 2. line 31. Robinson and Williams, 1992, is not referred in the bibliography. Pag. 4, line 13. Cheggour, 2008, is not referenced in bibliography. Pag. 4, lines 26 and 30. The reference Chardon and Riser (1998) must be Chardon and Riser, 1981. Page 7, line 24. Figure 9, must be Figure 8. Page 10, line 7. Figure 12, must be Figure 11. Reference list: Oliva et al. 2016 is not cited in the text.

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